Chapter 2. Recognizing competencies and valuing learning pathways in the digital age: a systematic review of innovative solutions

Gustavo Adolfo Angulo Mendoza
https://orcid.org/0000-0002-4997-678X, Université TÉLUQ (Canada)

Jean-Luc Bédard
https://orcid.org/0009-0007-4481-0119, Université TÉLUQ, (Canada)

Isabelle Savard
https://orcid.org/0000-0001-6366-7847, Université TÉLUQ, (Canada)

Valéry Psyché
https://orcid.org/0009-0003-7299-7807, Université TÉLUQ, (Canada)

Patrick Plante
https://orcid.org/0000-0002-0860-5798, Université TÉLUQ, (Canada)

Cathia Papi
https://orcid.org/0000-0002-5193-3906, Université TÉLUQ, (Canada)

Abstract: This chapter presents the results of a systematic review examining innovative digital solutions for the recognition of prior learning and competencies (RPL). Drawing on 171 empirical studies, it identifies and classifies the most widely used tools for documenting, assessing, validating, and certifying competencies acquired through formal, non-formal, informal, and workplace learning pathways. Three main categories of instruments are analyzed: digital certifications, digital portfolios, and competency logbooks, with particular attention to their adaptability across diverse educational, professional, and lifelong learning contexts. The review also examines key challenges reported in the literature, including institutional resistance, interoperability issues, limited stakeholder engagement, and variability in assessment practices, alongside evidence-based best practices and practical solutions that support effective implementation. Building on these findings, eighteen action pathways are proposed to guide the development of an integrated provincial digital ecosystem for competency recognition, thereby fostering a more inclusive learning society that supports lifelong learning, workforce mobility, and responsiveness to evolving labour market demands.

Keywords: recognition of prior learning, digital competency tools, open badges, digital portfolios, micro-credentials.

1. INTRODUCTION

In recent years, interest in digital tools and processes for the recognition of prior learning and competencies (RPL) has grown considerably, driven by the increasing heterogeneity of workers' learning trajectories (Deloitte Access Economics, 2017). Several converging factors fuel this trend: projected workforce renewal needs in the face of demographic ageing, the profound transformation of work methods in preparation for the fourth industrial revolution, and a growing demand for interpersonal and transversal skills by employers and industries worldwide (World Economic Forum, 2018). Added to these structural forces are the expanding market for short, flexible training programs and the growing expectations for verifiable, portable competency credentials that can be rapidly recognized across organizational and sectoral boundaries.

Traditional diplomas alone are no longer sufficient to attest to employability in a knowledge economy characterized by rapid change and multi-contextual learning. They do not necessarily reflect the full range of practical competencies sought in today's labour market, nor do they capture the value of competencies acquired outside institutional walls. New approaches, such as micro-learning, digital competency portfolios (e.g., Europass, MySkillsFuture, Skill Matcher) and open digital badges, have emerged as alternatives for recognizing competencies acquired in non-traditional educational frameworks (Brassier-Rodrigues, 2016; Chen-Wilson & Argles, 2010; Lockley et al., 2016). These digital instruments facilitate the modularization of training pathways, support more flexible and self-directed learning processes, and are better aligned with learners' career objectives and market needs.

Nevertheless, implementing such systems raises significant challenges: data security, interoperability between platforms and institutions, the quality and credibility of certifications, and the persistent absence of a shared reference framework, all of which complicate professional mobility and the international recognition of qualifications (Alexander et al., 2019; Chakroun & Keevy, 2018). In Canada and Quebec specifically, initiatives such as MesCertif and francobadges.ca demonstrate a growing appetite for digital credentialing, but insufficient harmonization across actors limits their systemic reach and impact (Bamowongo & Baril, 2023; Pelletier & Courcot, 2023). Digital certification platforms continue to multiply in colleges, universities, and professional orders, yet they persistently struggle to valorize informally acquired competencies, skills that are increasingly critical in a rapidly changing labour market (Cool et al., 2020).

Against this backdrop, it becomes essential to develop shared, open protocols for documenting, authenticating, and sharing all forms of learning (formal, informal, and non-formal) so as to ensure fair, inclusive, and comprehensive competency recognition (Allais, 2017; Bateman & Coles, 2017; Hart & Chakroun, 2019). Quebec's ambition to become a learning society, where continuous learning is valued throughout life to support personal, professional, and social development, requires transforming educational, economic, and social structures to integrate lifelong education at the core of public policy and organizational practices (Commission des partenaires du marché du travail, 2024; Taddei, 2019). A lack of systematic research on the specific features, challenges, and success conditions of available RPL tools currently limits the effectiveness of their deployment.

This chapter presents the results of a systematic knowledge synthesis examining digital mechanisms and tools for competency recognition, with the dual aim of proposing evidence-based

solutions adapted to the Quebec context and informing the development of a digital competency record that valorizes the full diversity of learning pathways. This research pursues three main objectives: 1) to identify the most effective digital tools, practices, and mechanisms for documenting, assessing, and recognizing competencies developed through formal, non-formal, informal, or work-based learning; 2) to classify these tools, practices, and mechanisms according to their adaptability to different learning pathways and modes of acquisition; and 3) to identify obstacles reported by researchers and practitioners, highlight recognized best practices, and propose practical solutions to facilitate the implementation of digital competency recognition systems that accommodate the heterogeneity of individual learning, job-seeking, and professional pathways.

2. METHOD

Our methodological approach is grounded in a systematic review structured according to the PICOS framework (Population, Intervention, Comparison, Outcome, Study characteristics), ensuring rigour and reproducibility in publication selection (Angulo Mendoza et al., 2025). Selected studies focused on digital RPL tools as well as institutional recognition initiatives across diverse educational and professional contexts. Target populations included adult learners in formal, non-formal, and informal settings, including career-changers and individuals with non-linear learning trajectories. Eligible studies presented empirical findings on the effectiveness, adaptation, or professional impact of RPL devices, published between 2014 and 2024 in English, French, Spanish, or Portuguese from peer-reviewed sources across multiple countries and educational systems. Purely theoretical articles, theses, and publications without a direct link to competency recognition were excluded.

Seven databases were systematically queried: Education Research Complete, ERIC, ScienceDirect, Taylor & Francis, Cairn, Érudit, and Google Scholar. Search terms were organized into three semantic clusters: (1) recognition and assessment processes (e.g., prior learning assessment, validation of experiential learning); (2) learning contexts (e.g., adult learning, workplace learning, informal and non-formal education); and (3) digital recognition technologies (e.g., digital badges, micro-credentials, portfolios, competency logbooks, training passports). Strategies were adapted to the syntax and indexing conventions of each database, and searches were conducted across all four eligible languages to maximize geographic and institutional coverage.

After de-duplication, 1,212 publications underwent a first screening on titles and abstracts; 984 were retained for full-text review. Applying the full eligibility criteria yielded a final analytical corpus of 171 articles. Selection was managed using Covidence, a recognized systematic review platform. Data extraction followed a structured six-category grid covering publication metadata, study design, tool characteristics, assessment and recognition processes, effectiveness and impact indicators, and supplementary contextual information. Manual coding by trained team members was supplemented by AI-assisted extraction using Elicit, a large language model tool enabling faster and more consistent analysis across the full corpus.

3. KEY RESULTS

3.1. Digital tools and mechanisms for competency recognition

The rapid evolution of technology has accelerated the transformation of systems for documenting, assessing, and recognizing competencies. The most frequently mentioned instruments in the reviewed literature include digital portfolios, micro-credentials, competency logbooks, and training passports. These complementary tools serve distinct but overlapping functions: collecting supporting evidence for specific competencies, organizing lifelong learning records, and centralizing training histories. Together, they support qualification identification and professional pathway planning across diverse contexts. Across the 171 publications analyzed, these instruments were examined in a wide range of institutional settings spanning North America, Europe, Australia, and Southeast Asia.

3.1.1. The rise of digital certifications

According to the reviewed publications, digital certifications are increasingly regarded as essential tools for validating and valorizing competencies in the digital ecosystem. They offer significant advantages for both issuers and recipients owing to their capacity to produce secure, verifiable, and easily shareable records. Open Badges, based on internationally recognized open standards developed by the IMS Global Consortium, represent the most widely adopted norm for recognizing competencies acquired through both formal and informal learning experiences. To constitute a complete and interoperable digital record, badges contain detailed metadata describing the targeted competency, evaluation criteria, mastery level, issuer identity, and date of issue. This structured metadata is what distinguishes Open Badges from simple image-based certificates and what makes them searchable, stackable, and transferable across platforms.

Micro-credentials, a more recent format occupying the space between traditional credentials and non-formal badges, are gaining considerable traction in post-secondary education and professional training. They provide learners with granular, modular evidence of competencies linked to specific labour market needs and are particularly valued for their ability to demonstrate employability-relevant skills in a concise, verifiable form (Maina et al., 2022). Dedicated platforms that automate administrative processes have further facilitated the adoption of digital certifications. Some institutions have integrated these systems directly into their learning management platforms, automatically producing and issuing certifications once specified performance conditions are met. This automation reduces processing time, minimizes human error, and improves the traceability and auditability of issued credentials. More broadly, digital certifications enable institutions, businesses, and individuals to respond more effectively to rapid labour market changes, while offering a secure and adaptable mechanism for certifying and communicating acquired competencies across organizational and national boundaries.

3.1.2. Digital portfolios: dynamic archives of achievements and learning

Digital portfolios constitute a more holistic and narrative approach to competency documentation, functioning as dynamic digital collections that present learning achievements, reflections, and supporting evidence over time. Unlike badges, which are granular and competency-specific, portfolios provide a comprehensive and contextualized representation of an individual's

growth, strengths, and professional identity. These repositories allow individuals to compile evidence of their capabilities through diverse artifacts: examples of work, completed projects, certifications, testimonials, and reflective writing, that collectively demonstrate learning trajectory and competency development. Digital portfolios are particularly useful for supporting cross-cutting, evidence-based assessments of achievements that transcend the boundaries of any single course or credential.

Studies highlight several additional pedagogical benefits of digital portfolios: they allow users to connect their learning experiences to concrete professional contexts and actions; they enable learners to curate and demonstrate their skills through deliberately selected evidence; and, when combined with reflective journals or guided practice activities, they promote the development of metacognitive awareness: the capacity to reflect on one's own learning processes, identify gaps, and plan for further development. The integration of digital portfolios in educational contexts has shown strong potential. Faculty who incorporates portfolios into their courses report them to be effective tools for helping students identify and articulate the competencies most sought by employers. Students, for their part, report that the process of constructing a portfolio helps them to recognize and verbalize their core competencies while deepening their understanding of the labour market's expectations. The pedagogical value of digital portfolios thus resides not only in the final product (the portfolio itself) but in the reflective process of its construction.

3.1.3. Competency logbooks and training passports

Competency logbooks document learning experiences and professional development activities by systematically recording essential information about tasks accomplished, training completed, qualifications obtained, and learning realized throughout an individual's educational or professional pathway. In educational and training settings, a competency logbook serves as a structured, often chronological tool that makes visible a learner's progression and achievements over time. It presents concrete supporting evidence of developed competencies, such as supervisor assessments, completed diplomas or certifications, performance records, or testimonials, allowing recruiters and institutions to appreciate the breadth and depth of an individual's talents in specific domains. This structure facilitates both the traceability of competency development and its practical mobilization in professional contexts.

Recent research on competency tracking tools highlights the progressive evolution of the logbook concept toward fully digital alternatives that leverage technology to enable real-time data collection, automated progress monitoring, and richer interaction between learners, trainers, and supervisors. These digital platforms facilitate immediate team communication, instant access to program updates, and a more dynamic and living representation of competency development. Training passports (a related but distinct instrument) function as personal records regrouping all training undertaken, certifications obtained, and competencies acquired over a career, primarily oriented toward professional contexts and continuing education. Together, these tools constitute the structural spine of a comprehensive and interoperable digital ecosystem for RPL, each serving a different but complementary function in documenting the full arc of an individual's learning journey.

3.2. Classification of digital tools by learning pathway

Competency recognition is increasingly central to the development of a lifelong learning culture in contexts where individuals acquire competencies across a growing diversity of educational and professional settings. The literature reviewed reveals that the relevance, effectiveness, and limitations of each tool type are closely tied to the nature of the learning pathway in which they are deployed. No single instrument is universally superior; rather, the most effective approaches are those that articulate rigor with flexibility, enabling documentation, assessment, and recognition of competencies acquired across formal, non-formal, informal, and workplace contexts.

In formal learning contexts (universities, technical colleges, professional schools) competency recognition typically relies on structured, standardized mechanisms aligned with institutional curricula and accreditation frameworks. Portfolios and digital badges are among the most commonly used complementary tools in this context. Portfolios allow learners to systematically document achievements linked to their training pathway, demonstrating both competencies and reflective practice through multimedia artifacts aligned with predefined learning outcomes. Digitally issued micro-credentials add granularity and transferability to the recognized competencies, providing verifiable evidence that can be mobilized rapidly across employment and further education contexts. Nonetheless, the normative character of formal-context tools and their dependence on institutional referentials can create barriers for individuals who have acquired significant competencies outside traditional educational settings, underscoring the need for more permeable and inclusive frameworks.

In non-formal learning contexts (professional development programs, community education initiatives, trade union training, or employer-sponsored workshops) recognition tools require considerably greater flexibility. The literature highlights the frequent use of competency frameworks, descriptive attestations, and hybrid validation models designed to accommodate varied and heterogeneous forms of evidence such as work demonstrations, project portfolios, employer testimonials, or peer endorsements. Portfolio-based approaches have proven particularly effective in vocational training settings, where trainers can document competencies acquired through experience and practice even in the absence of formal certification. The modular structure of non-formal recognition devices promotes their adaptability to diverse community and organizational contexts, but their credibility ultimately depends on the engagement of relevant stakeholders and their alignment with professional sector standards.

The recognition of informal learning, including self-directed learning, experiential learning, and competencies acquired through everyday activities, volunteering, or civic engagement, presents the most complex challenges for any recognition system. Innovative digital solutions analyzed in the literature include open badges, blockchain-based certifications, and AI-assisted assessment platforms capable of analyzing unstructured competency evidence. Blockchain technology offers secure and virtually tamper-proof records of prior learning, while AI-powered systems can map unstructured evidence to formal competency frameworks, potentially enabling large-scale automated recognition. These mechanisms are particularly suited to non-linear learning pathways, such as those followed by self-taught professionals, artists, entrepreneurs, or immigrants with foreign credentials. However, the absence of institutional oversight and standardized validation criteria raises legitimate concerns about objectivity, reliability, and po-

tential misuse, underscoring the critical importance of transparent validation procedures and, where possible, third-party endorsement by trusted entities.

Workplace learning and corporate training require recognition tools closely integrated with organizational processes, human resource management systems, and sectoral standards. Micro-credentials co-developed with employers, re-validation portfolios, and dynamic competency-mapping platforms are increasingly deployed to document and assess professional competencies in real time. These devices facilitate the recording of workplace achievements, the integration of supervisory feedback, and alignment with evolving labour market demands. They generate actionable data both for employees managing their career development and for employers seeking to identify skill gaps and plan strategic workforce development. Their effectiveness, however, is contingent on adequate organizational infrastructure, digital capacity within firms, and genuine, sustained employer engagement in the recognition process, conditions that are frequently uneven across sectors and organizational sizes.

3.3. Challenges, best practices, and solutions

The implementation of digital competency recognition systems faces multiple persistent obstacles, while the literature simultaneously highlights promising practices and evidence-based solutions that strengthen the effectiveness, credibility, and sustainability of these systems. Understanding both dimensions is essential for moving from fragmented pilot projects toward scalable, equitable, and institutionally embedded recognition ecosystems.

A recurring obstacle across diverse national contexts is institutional and organizational resistance to change. The adoption of micro-credentials and digital portfolios in higher education often requires significant curricular transformation, administrative reorganization, and cultural shifts in how learning and teaching are evaluated, hanges that sometimes generate reluctance among teaching staff, curriculum committees, and institutional governance bodies (Maina et al., 2022). This resistance is compounded by the complexity of integrating new digital tools into existing administrative and pedagogical structures, the absence of nationally recognized common standards for credentialing, and the need for entirely new forms of cross-institutional coordination. Beyond higher education, Ferns and Comfort (2014) document how insufficient pedagogical preparation of staff for the demands of digital portfolios, combined with fragmented program integration, limits the perceived relevance and measurable impact of these tools on student learning and employability outcomes.

Technical and ergonomic obstacles present equally significant challenges. The literature consistently documents interoperability problems between digital systems, concerns about data security and personal information protection, and persistent accessibility issues for users with unequal digital literacy, a concern that is particularly acute for older workers, individuals with disabilities, newcomers, and those with limited formal education (McGreal, 2023). Sidebotham et al. (2018) found that one-third of students in their study encountered significant navigational difficulties using digital portfolio platforms, pointing to the urgent need for intuitive user interface design and adequate technical support. The administrative burden associated with documenting, assessing, and validating competencies in individualized, evidence-based systems also represents a substantial barrier, particularly for institutions and professionals with limited time and human resources.

A third major challenge is the subjectivity and variability of assessment practices. Portfolio-based and reflective assessment models, while they enable rich and nuanced qualitative data collection, are vulnerable to divergent interpretations and evaluator biases, particularly when assessing transversal or socio-emotional competencies. The absence of standardized assessment rubrics and the reliance on personal narratives and self-selected evidence may undermine the reliability, comparability, and perceived credibility of recognition processes, both for learners who invest significant effort and for external stakeholders such as employers who must decide whether to trust the resulting credentials. This challenge is compounded by the fragmentation of recognition practices across institutions and sectors, and by the absence of a commonly recognized national framework against which diverse competencies can be mapped and compared.

Despite these challenges, literature identifies a robust set of promising practices aimed at strengthening the credibility, inclusiveness, and long-term viability of digital recognition systems. One particularly effective practice involves the use of multipartite assessment committees and hybrid evaluation models, as described by Lepire (2024), in which quantitative and qualitative evidence is analyzed by structured expert panels representing multiple stakeholder perspectives. This approach enhances both the rigor and the contextual sensitivity of the recognition process, while distributing evaluative authority across a broader community of practice. The use of explicit, publicly available assessment rubrics, accompanied by exemplary work samples, also contributes to normalizing expectations and providing practical support to all participants.

Personalized accompaniment of candidates throughout the recognition process is consistently identified as a key success factor. Grison and Bertineaud (2019) emphasize the critical importance of preparatory workshops, individualized feedback sessions, and the sustained availability of mentors or advisors to guide users through what can be a demanding and emotionally significant process. Such accompaniment is particularly essential for populations facing structural disadvantages, including individuals without formal qualifications, recent immigrants, adults returning to education after long absences, or persons with disabilities, for whom adapted pathways, flexible timelines, and proactive accommodation measures can determine whether participation in recognition processes leads to meaningful inclusion or renewed exclusion.

Collaboration among educational institutions, employers, professional orders, and community organizations is equally fundamental to building the social trust and institutional legitimacy that digital recognition systems require. Programs developed in genuine partnership with professional sectors and employability organizations strengthen not only the labour market value of resulting certifications but also facilitate smoother professional transitions, notably for newcomers whose foreign-acquired competencies are often systematically undervalued (Cukier et al., 2024). Communication across stakeholder communities and co-responsibility for process governance foster shared understanding and commitment to sustainable implementation.

The literature further recommends a progressive, iterative, and modular approach to deploying digital recognition systems, allowing institutions to validate technological choices and refine implementation processes through controlled pilots before broader scaling (Grison & Bertineaud, 2019). The adoption of standardized data protocols and well-documented application programming interfaces (APIs) would directly address interoperability challenges and

reduce system integration costs for participating organizations (Maina et al., 2022). Ongoing capacity-building through dedicated training programs for evaluators, coordinators, and technical staff is essential for maintaining quality, ensuring consistent practices, and preventing administrative bottlenecks (Lepire, 2024). Finally, inclusive and accessibility-conscious design, including multilingual interfaces, screen-reader compatibility, and low-bandwidth alternatives, is necessary to reduce digital inequalities and ensure that recognition mechanisms do not replicate or deepen existing social exclusions (McGreal, 2023). Policy alignment and the establishment of national or sectoral quality assurance frameworks represent additional structural levers for overcoming legislative and regulatory obstacles, as illustrated by mature systems such as Belgium's VAE (*validation des acquis de l'expérience*).

4. SOLUTIONS AND RECOMMENDATIONS

Drawing on the totality of evidence assembled in this systematic review, we propose eighteen action pathways organized around three axes for government ministries, institutional partners, employers, and all stakeholders invested in building an effective, equitable, and sustainable competency recognition ecosystem.

4.1. Optimizing a digital space for competency recognition

The fragmentation of recognition tools and the absence of shared technical infrastructure constitute the most fundamental structural obstacle to effective competency recognition. We recommend:

Establishing a unified provincial digital space integrating, within a single platform, the complementary functionalities identified in this study: documentation (digital portfolio), certification (digital badges and micro-credentials), and structured pathway organization (competency logbook). This platform should be designed as a common, interoperable infrastructure accessible to all actors in the educational system and labour market, promoting the coherence, readability, and portability of recognized competencies. It should also include tools for reflective practice and self-directed career planning.

Establishing interoperability protocols and standards enabling secure, fluid data exchange between existing platforms (educational institutions, professional orders, sectoral organizations), in close collaboration with all sectoral and institutional partners. These standards should draw on internationally recognized open formats such as the Open Badges standard and JSON-LD metadata, while also providing publicly documented, secure APIs to facilitate harmonious integration with existing institutional systems.

Defining a common metadata framework for digital certifications, including standardized descriptions of attested competencies, evaluation criteria, mastery levels, issuing organization, and acquisition context, supported by a semantic indexing system enabling automatic mapping between different formulations of the same competency across different institutional referentials.

Integrating advanced traceability mechanisms based on distributed ledger technologies (such as blockchain) to guarantee the authenticity and verifiability of digital certifications over time, while maintaining strict user control over personal data and full compliance with privacy legislation.

Designing a personalized user experience through adaptive interfaces that account for user profiles (learner, employer, trainer, assessor) and digital literacy levels, integrating transparent decision-support tools that suggest training pathways or professional perspectives aligned with documented competencies, and offering selective-sharing functionalities enabling users to generate tailored views of their competency portfolio for specific audiences and contexts.

4.2. Adaptability of instruments to diverse learning pathways

Developing a modular competency framework structured at different levels of granularity, in coherence with the national qualifications framework, to enable progressive and flexible recognition of prior learning, with explicit bridges between different types of recognition to promote the transferability and capitalization of competencies acquired across varied learning contexts.

Implementing analysis and recommendation mechanisms to support the construction of personalized learning pathways, including competency self-diagnosis tools, procedures for analyzing convergences between different forms of RPL, and recommendation systems for complementary training aligned with attested competencies, professional objectives, and evolving labour market needs.

Supporting experimentation and systematic research on the recognition of transversal and socio-emotional competencies, including collaboration, critical thinking, adaptability, stress management, and empathy, which are often acquired informally yet are essential in contemporary professional environments, through multimodal assessment approaches combining self-assessment, observation in real or simulated situations, and structured peer evaluation.

4.3. Levers for overcoming obstacles

Establishing a collaborative, multipartite governance structure for the digital competency recognition ecosystem, including representatives from all relevant ministries (Education, Higher Education, Employment and Social Solidarity, Economy), educational institutions, employers, unions, and community organizations.

Creating an advisory committee representing diverse stakeholder communities to ensure that developed tools and processes genuinely respond to the needs and expectations of all user groups, including those traditionally underserved by formal recognition systems.

Establishing an observatory of recognition practices tasked with documenting, analyzing, and disseminating innovations, experimental results, and best practices in competency recognition, both within Quebec and internationally, to inform evidence-based policy and practice development.

Developing a continuing professional education program for education and employment professionals on methodologies for assessing and recognizing competencies acquired in varied learning contexts, with particular attention to reflective practice, portfolio assessment, and the use of digital platforms.

Producing co-constructed guides and practice frameworks to harmonize assessment processes across institutions and sectors while preserving sufficient flexibility to account for the contextual diversity of learning pathways and professional environments.

Creating intersectoral communities of practice to foster peer learning, experience-sharing, and collaborative innovation among practitioners in competency recognition across educational, professional, and community settings.

Adopting an iterative, evidence-informed approach to deploying the digital recognition ecosystem, prioritizing piloting in sectors with critical competency recognition needs in order to validate technological choices, refine implementation mechanisms, gather user feedback, and foster progressive, concerted scaling across the provincial system.

Establishing a structured evaluation framework to measure the longitudinal impact of recognition devices on learning trajectories, professional integration, competency mobility, and employer satisfaction, with mechanisms for continuous quality improvement based on user experience and evolving labour market signals.

Strengthening personalized accompaniment services to support individuals in their competency recognition journeys, particularly those encountering barriers linked to digital skills, language, disability, or unfamiliarity with formal credentialing systems, while developing accessible self-study resources that facilitate the progressive, autonomous appropriation of RPL concepts and tools.

Creating a specialized advisory network embedded within adult education centres, community organizations, and employability support services, to provide accessible, context-sensitive guidance to diverse populations, including newcomers, persons without formal qualifications, and those in career transition, navigating digital recognition processes.

The concerted implementation of these recommendations constitutes a strategic lever for building a learning society in Quebec in which competencies acquired across all learning contexts are equitably valorized. Although deployment requires significant structural investment, the expected benefits, in terms of human capital development, training-employment alignment, reduced skills mismatches, support for labour market integration of marginalized populations, and systemic resilience, fully justify these efforts in a context marked by accelerating economic transformation, demographic ageing, and intensifying competition for skilled workers.

5. FUTURE RESEARCH DIRECTIONS

This systematic review also reveals significant knowledge gaps that point to productive future research directions. The following avenues emerge as particularly important for optimizing competency recognition in a constantly evolving digital ecosystem:

Analyzing the longitudinal impact of digital recognition devices on educational and professional trajectories, particularly their contribution to workforce integration and retention, upward professional mobility, lifelong learning motivation, and psychological well-being, as well as their social acceptability, the degree of trust placed by stakeholders in the validity of recognized competencies, and the readability of resulting credentials for diverse labour market actors.

Exploring the conditions, ethical frameworks, and governance models for integrating artificial intelligence and blockchain technologies in competency certification, particularly regarding system interoperability, algorithmic transparency, personal data protection, equity concerns, and institutional and social acceptability.

Deepening research on hybrid assessment models and the complementarity between micro-credentials, digital portfolios, competency logbooks, and traditional credentials, with a focus on ensuring equitable, transferable, and meaningful recognition across all learning contexts and population groups.

Investigating the conditions that best favour employer, professional order, and sectoral organization engagement in competency recognition ecosystems, including effective awareness-raising strategies, incentive structures, and multipartite governance models, particularly in the context of developing a national qualifications framework and a competency record with broad national reach.

Identifying the most effective accompaniment, training, and technical support measures for ensuring equitable participation across all populations in the emerging learning society, and for actively preventing digital exclusion among groups facing technological, linguistic, cultural, or socioeconomic barriers.

6. CONCLUSION

This systematic review confirms that digital tools for the recognition of prior learning and competencies (open badges, micro-credentials, digital portfolios, and competency logbooks) constitute a rich and evolving ecosystem, capable of documenting and valorizing the full diversity of learning pathways when thoughtfully designed, contextually deployed, and institutionally supported. No single instrument is universally superior; effectiveness depends on the learning context, the population served, and the governance structures surrounding implementation. Persistent obstacles like fragmented infrastructure, institutional resistance, uneven digital literacy, and inconsistent assessment practices, remind us that technology alone cannot drive systemic change. Sustainable transformation requires shared standards, multipartite governance, dedicated accompaniment for learners, and ongoing investment in the capacity of professionals who administer recognition processes. The eighteen action pathways proposed here offer a practical roadmap for stakeholders committed to building an integrated, inclusive, and credible provincial ecosystem for competency recognition. Realizing this vision demands coordinated effort across government, educational institutions, employers, and civil society, but the potential gains in equity, workforce development, and social cohesion make it a strategic imperative for Quebec's future as a learning society.

ACKNOWLEDGEMENTS

This research was supported by the Fonds de recherche du Québec – Société et culture and the Ministère de l'Économie, de l'Innovation et de l'Énergie [grant number 2025-0SOS-356957].

REFERENCES

Alexander, B., Ashford-Rowe, K., Barajas-Murphy, N., Dobbin, G., Knott, J., McCormack, M., Pomerantz, J., Seilhamer, R., & Weber, N. (2019). *EDUCASE Horizon report: 2019 Higher Education Edition.* https://www.learntechlib.org/p/208644/

Allais, S. (2017). Labour market outcomes of national qualifications frameworks in six countries. *Journal of Education and Work, 30*(5), 457-470. https://doi.org/10.1080/13639080.2016.1243232

Angulo Mendoza, G.A., Plante, P., Papi, C., Savard, I., Bédard, J-L., & Psyché, V. (2025). *Reconnaissance des compétences et valorisation des parcours d'apprentissage à l'ère du numérique : une revue systématique des solutions innovantes.* Université TÉLUQ, i-TEQ. https://r-libre.teluq.ca/3811/

Bamowongo, É., & Baril, D. (2023, March 5). *Lancement de Francobadges.ca: Une plateforme innovante pour la reconnaissance des acquis* [Press release]. RESDAC and ICÉA. https://acortar.link/hN3P2m

Bateman, A., & Coles, M. (2017). *Towards quality assurance of technical and vocational education and training.* UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000259282

Brassier-Rodrigues, C. (2016). Comment valoriser les compétences liées à la mobilité internationale? Analyse de l'efficacité communicationnelle de l'Europass Mobilité. *Journal of International Mobility, 4*(1), 59-74. http://doi.org/10.3917/jim.004.0059

Chakroun, B., & Keevy, J. (2018). *Digital credentialing: Implications for the recognition of learning across borders*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000264428

Chen-Wilson, L., & Argles, D. (2010). Towards a Framework of a Secure E-Qualification Certificate System. In *Proceedings of the 2010 Second International Conference on Computer Modeling and Simulation*, (Vol. 1, pp. 493–500). https://doi.org/10.1109/ICCMS.2010.195

Commission des partenaires du marché du travail. (2024). *Plan 2023-2028 issu du rapport quinquennal sur la loi favorisant le développement et la reconnaissance des compétences de la main-d'œuvre.* Gouvernement du Québec. https://acortar.link/6ng1aP

Cool, J., Pelchat, M., & Stasse, S. (2020). CADRE21: Un modèle québécois de développement professionnel reconnu et accessible pour tous les enseignants francophones. *Revue internationale des technologies en pédagogie universitaire, 17*(1), 76-83. https://doi.org/10.18162/ritpu-2020-v17n1-14

Cukier, W., Mo, G.Y., Karajovic, S., Borova, B., & Nagpal, R. (2024). Combler l'écart de compétences entre les nouveaux arrivants et l'industrie : preuves provenant du projet d'innovation de la main-d'œuvre et de l'inclusion. *Revue hybride de l'éducation. 8*(3). https://doi.org/10.1522/rhe.v8i3.1470

Deloitte Access Economics. (2017). *Soft skills for business success: Building Australia's future workforce.* DeakinCo. https://acortar.link/2qnnAn

Ferns, S., & Comfort, J. (2014). ePortfolios as evidence of standards and outcomes in work-integrated learning. *Asia-Pacific Journal of Cooperative Education, 15*(3), 269-280. https://eric.ed.gov/?id=EJ1113655

Grison, M., & Bertineaud, V. (2019). Différent et Compétent Réseau: Quand l'innovation est profitable à tous. *Pratiques en santé mentale, 65*(3), 20–27. https://doi.org/10.3917/psm.193.0020

Hart, J., & Chakroun, B. (2019). World Reference Levels for Lifelong Learning: A tool for comparison and recognition of learning outcomes. In UIL, Cedefop, ETF, & UNESCO

(Eds.), *Global inventory of regional and national qualifications frameworks 2019* (Vol. I, pp. 13-25). UIL. http://doi.org/10.2816/908029

Lepire, C. (2024). Cadre de référence réflexif pour élaborer, implanter et évaluer un dispositif de reconnaissance d'acquis et de compétences. *Revue hybride de l'éducation, 8*(3), 1-22. https://doi.org/10.1522/rhe.v8i3.1491

Lockley, A., Derryberry, A., & West, D. (2016). Drivers, Affordances and Challenges of Digital Badges. In D. Ifenthaler, M. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials* (pp. 55-70). Springer. https://doi.org/10.1007/978-3-319-15425-1_4

Maina, M.F., Guàrdia Ortiz, L., Mancini, F., & Martinez Melo, M. (2022). A micro-credentialing methodology for improved recognition of HE employability skills. *International Journal of Educational Technology in Higher Education, 19*(1), 10. https://doi.org/10.1186/s41239-021-00315-5

McGreal, R. (2023). Blockchain and Micro-Credentials in Education. *International Journal of E-Learning & Distance Education, 38*(1), 1–17. https://doi.org/10.55667/10.55667/ijede.2023.v38.i1.1250

Pelletier, S., & Courcot, B. (2023). *Pour faire valoir toutes ses compétences: La plateforme numérique de microattestations.* ICÉA. https://acortar.link/zR0jxP

Sidebotham, M., Baird, K., Walters, C., & Gamble, J. (2018). Preparing student midwives for professional practice: Evaluation of a student e-portfolio assessment item. *Nurse Education in Practice, 32*, 84-89. https://doi.org/10.1016/j.nepr.2018.07.008

Taddei, F. (2019). La formation tout au long de la vie, au cœur de la société apprenante. *Administration & Éducation, 161*(1), 119–121. https://doi.org/10.3917/admed.161.0119

World Economic Forum. (2018). The future of jobs report 2018. http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf